370-2

Z-F-29

INSTRUCTION MANUAL

REGATRON

POWER SUPPLY

MODEL 222A

SERIAL No. _____

ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED
EATONTOWN · NEW JERSEY

TELEPHONE: (201) LIberty 2-0300 TWX: (201) 542-2273 CABLE: ELMEASCO

Warranty

Electronic Measurements instruments are guaranteed to be free from defects in material and workmanship for one year from the date of purchase (except for tubes, fuses and batteries). Our liability under this warranty is limited to repairs and adjustments or replacements of defective parts or instruments when the fault is a direct result of defective materials or workmanship in the manufacture of the apparatus. This warranty covers service for the first year, except for transportation to and from the factory. If any fault develops in the equipment, the following steps should be taken:

1. Notify ELECTRONIC MEASUREMENTS CO., INC. Give full particulars of the difficulty and include the serial number of the instrument in question. On receipt of this information, we will give you service information or shipping instructions.
2. On receipt of shipping instructions, forward the appartus to us, prepaid, and we will make repairs and adjustments immediately at the factory.
3. If the fault has been caused by misuse, or abnormal conditions of operation, as disclosed by our examination, repairs will be billed at cost. In this case, an estimate of the cost will be submitted before work is started.

ELECTRICAL STANDARDS

All company primary standards are either certified directly or are traceable to certification by the National Bureau of Standards.

CLAIM FOR DAMAGE IN SHIPMENT

This instrument received comprehensive visual and electrical inspections before shipment. Immediately upon receipt from the carrier, and before operation, this instrument should be inspected visually for damage caused in shipment. If such inspection reveals internal or external damage in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. When referring to this instrument, always include the model and serial numbers.

REGATRON
POWER SUPPLY

MODEL 222A

SERIAL No. _____

CODE F1062

ELECTRONIC
MEASUREMENTS
COMPANY, INCORPORATED
EATONTOWN · NEW JERSEY

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TABLE OF SPECIFICATIONS

DATA ON INDIVIDUAL MODELS COVERED BY THIS MANUAL.

Model	Outputs		Regulation				Max. Ripple MV RMS	Dimensions In Inches			Weight In Pounds
			Line		No Load To Full Load						
	Volts	Current	%	V	%	V		H	W	D	
2300	0-300 V DC	0-1.5 AMP	0.02	0.05	0.015	0.02	1	10½	19	15	80
	6.3 V AC CT	10 AMP	—	—	—	—	—				
209B	0-600 V DC	0-600 MA	0.02	0.05	0.01	0.02	0.5	10½	19	15	75
	0-150 V DC	0-5 MA	0.5	—	0.5% at max. set.		0.5				
	6.3 V AC CT	10 AMP	—	—	—	—	—				
219B	0-600 V DC	0-1 AMP	0.02	0.05	0.01	0.05	0.5	10½	19	15	80
	0-150 V DC	0-5 MA	0.5	—	0.5% at max. set.		0.5				
	6.3 V AC CT	10 AMP	—	—	—	—	—				
222A	0-1000 V DC	0-500 MA	0.02	0.05	0.01	0.02	1	10½	19	15	80
	6.3 V AC CT	10 AMP	—	—	—	—	—				
	300 V DC	5 MA	0.02	0.05	0.01	0.02	1				

DATA ON ALL MODELS.

Modulation Input ..... Models 209B and 219B only.

Output Impedance ..... Less than 0.01 ohm to 1000 cps; 0.1 ohm to 10 kc; 1 ohm to 100 kc.

Transient Response ..... For step change from no load to full load or full load to no load, output recovers to within dc regulation limits within 2 milliseconds.

Vernier Range ..... 3 volts.

Ac Input ..... 105 to 125 volts rms, 50 to 60 cps, single phase power.

Output Polarity ..... Swinging link for positive or negative output with respect to ground, or floating output.

Terminations ..... Front: Universal insulat binding posts.

Rear: Barrier type termin strip.

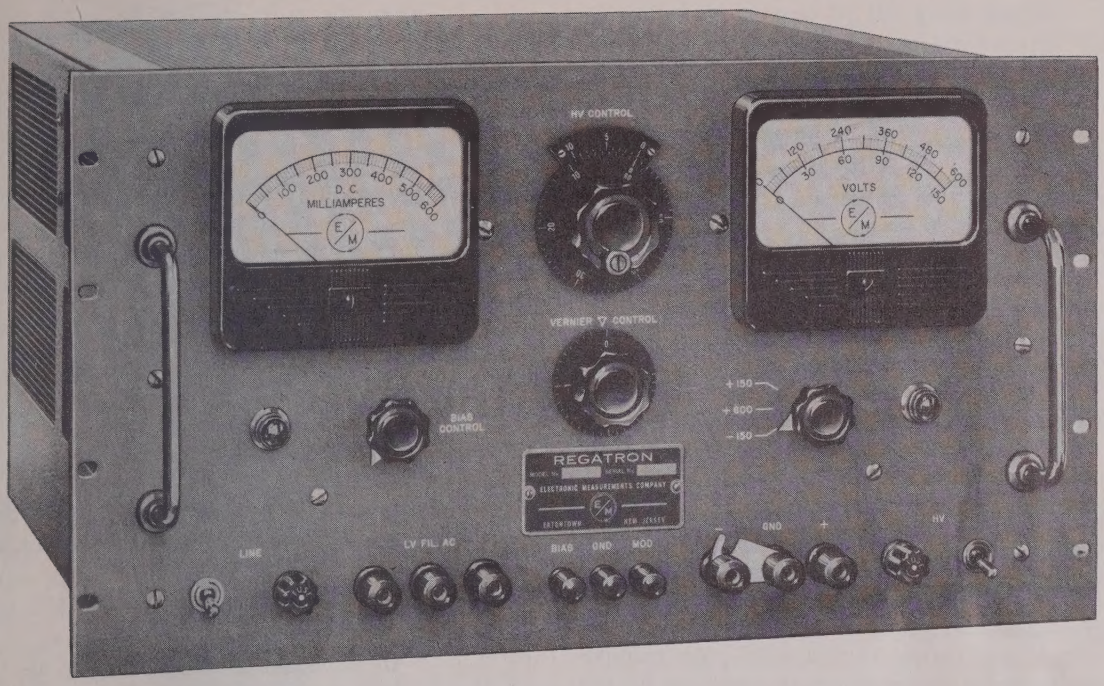
Line cord: 3 - conduct type.

Meters ..... Voltmeter and ammet Accuracy is ±2%, f scale.

Overload Protection ..... Line and high voltage c cuits fused; time delay r lay included.

Mounting ..... Unit fits standard 19-in rack and has rubber fe for mounting on table.

Finish ..... Federal gray wrinkle wi engraved panel markings



SECTION I
DESCRIPTION

1-1. GENERAL. This power supply is a wide-nge source of voltage-regulated dc power. It has een designed for a wide variety of applications re-uiring closely regulated high voltage of high reso-tion and substantial current capabilities. Output oltage is continuously adjustable by means of a cali-rated HV control, and a vernier permits precise selec-on of the output from 3 volts down to a fraction of a olt. Models 209B and 219B feature bias outputs hich are continuously variable from zero to —150 olts, and also modulation inputs for superimposing of c signals on regulated dc outputs. All models offer 00-volt dc reference outputs and 6.3-volt ac out-uts with centertap. Outputs can be taken from the ont panel binding posts or from a terminal strip ounted at the rear of the unit. Additional detailed erformance data is given in the Table of Specifica-ons, page iv.

2. USE AS A VOLTAGE STANDARD. This iit may be employed to supply calibrated voltages from zero to the maximum HV control setting. Calibration applies for an output current of 50 milliamperes or less, and for a Vernier setting of zero. If the unit has been operating for some time as a source of power at high current, and it is desired to employ the unit as a source of standard voltage, the load should be completely removed for 15 to 20 minutes so that the internal fan can reduce and stabilize the temperature. This unit should be calibrated at an ambient temperature of 21°C (70°F). The change due to temperature is approximately 0.0045% per degree centigrade.

1-3. USE AS A POWER SOURCE. When used as a power source at high currents, the calibration is still useful at somewhat reduced precision. The cabinet should be placed in a location where adjacent equipment will not completely block the ventilation openings, particularly the fan intake. If mounted in a rack, this consideration should be kept in mind.

SECTION II
OPERATION

WARNING

Lethal voltages appear at the output terminals and at various points within the power supply. Extreme care must be exercised to avoid accidental contact with any exposed load connections or leads. Load connections must be made with the power supply turned off.

2-1. PREPARATION. Immediately upon unpacking the power supply, perform a visual inspection for internal or external damage incurred in shipment. If damage is discovered, follow the Claim for Damage in Shipment instructions on the Warranty, printed on the front inside cover of this instruction manual. Prior to placing the power supply in operation for the first time, make certain that all shipping blocks have been removed from inside the unit, and check to see that all tubes are securely seated in their sockets.

2-2. INSTALLATION. This power supply may be placed on a table or mounted in a standard 19-inch rack with sufficient depth to accommodate the chassis. In rack mounting, make certain that adjacent equipment does not completely block the power supply ventilation openings. The covers may be removed to increase ventilation when required by ambient conditions.

2-3. INITIAL CONTROL SETTINGS. Before plugging the line cord into the ac power outlet, check that:

a. LINE switch is off (down).

b. HV switch is off (down).

c. HV CONTROL is at minimum (fully counterclockwise).

d. VERNIER CONTROL is at minimum (fully counterclockwise).

e. BIAS CONTROL (models 209B and 219B only) is at minimum (fully counterclockwise).

f. Meter switch (models 209B and 219B only) is at +600.

2-4. REVERSAL OF POLARITY. To change output polarity, loosen the dc output and GND binding posts, swing the ground link to the desired output post, and retighten the posts. For floating output do not connect the link to either terminal.

WARNING

To eliminate a shock hazard, always make certain that the case or ground of external equipment is connected to the grounded side of the power circuit.

2-5. OPERATION. Operate the power supply as follows:

a. Plug the line cord into the ac power outlet.

b. Connect a load between the + and — output terminals. It should be noted that the regulation of this unit is measured at the output terminals. To maintain the desired regulation in actual service, the load wires must be heavy enough to prevent substantial voltage drops between output terminals and the load.

c. Set the LINE switch to the on (up) position. The green indicator lamp should light. A time delay relay permits the mercury vapor rectifier tubes to warm up prior to the application of high voltage. The delay period is approximately one minute.

d. Set the HV CONTROL and VERNIER CONTROL to the required output voltage (refer to paragraph 2-6.)

e. Set the HV switch to the on (up) position, applying voltage to the load. The red indicator lamp should light.

WARNING

The red indicator lamp comes on when the HV switch is turned on, even if the delay period is incom-

plete, to indicate that the high voltage may come on at any time. Lethal voltage WARNING should be observed whenever this switch is on.

2-6. ADJUSTMENT OF OUTPUT VOLTAGE.

2-7. HV CONTROL. To adjust the HV CONTROL, proceed as follows:

a. Model 2300. The HV CONTROL covers the range from 0 to 300 volts in ten turns, providing 30 volts per turn. To determine the correct output voltage, it is necessary to know the last multiple of 30 swept by the dial. Thus, by noting the increments between which the reading lies, and adding the dial reading to the last previous multiple of 30 the total reading is determined. For example, if the voltmeter indicates between 210 and 240 volts, and the dial indicates 22.3, then the output voltage is 210 + 22.3 = 232.3.

b. Models 209B and 219B. The HV CONTROL covers the range from 0 to 600 volts in ten turns, providing 60 volts per turn. To determine the correct output voltage, it is necessary to know the last multiple of 60 swept by the dial. To make this possible, the voltmeter has cardinal markings every 10 percent from zero to 600 volts. Thus, by noting the increments between which the reading lies, and adding the dial indication to the last previous multiple of 60, the total reading is determined. For example, if the voltmeter indicates between 240 and 300 volts, and the dial indicates 25.5, then the output voltage is 240 + 25.5 = 265.5.

c. Model 222A. The HV CONTROL covers the range from 0 to 1000 volts in ten turns, providing 100 volts per turn. The voltage is indicated directly by the digits at the front of this control, and also by the front panel voltmeter.

2-8. VERNIER CONTROL. Calibration applies with the VERNIER CONTROL set at zero. When the VERNIER CONTROL is set to any value between zero and 3 volts, the indicated voltage is added to the output voltage at any point in the range.

2-9. BIAS VOLTAGE. Models 209B and 219B features a zero to 150-volt bias output which may be monitored on the panel voltmeter by setting the Meter switch to the −150 position. Bias may then be adjusted with the BIAS CONTROL. A maximum current of 5 millamperes may be drawn from this source. The positive terminal of this bias voltage is permanently connected to the negative terminal of the high voltage output. Note that with positive grounded and any output voltage other than zero, the entire bias voltage is displaced from ground by the given amount. The two terminals of the bias voltage are brought out to the front panel at the BIAS and — binding posts.

2-10. REFERENCE VOLTAGE. A reference voltage of exactly 300 volts at a maximum current of 5 milliamperes is provided by this power supply. The positive terminal of this source is also permanently connected to the negative output terminal. In models 2300, 209B, and 219B the reference voltage is available at the bottom of the reference unit on the exposed bus marked with red paint. The reference subassembly is at the left of the chassis (from top front). In model 222A the reference voltage is made available at the REF binding posts.

2-11. MODULATION. In models 209B and 219B the output voltage may be offset by a dc signal or alternatively modulated by an ac signal by inserting the appropriate voltage into the MOD binding post. The other side of the modulating source should be returned to the small ground post adjacent to the MOD post. When the positive terminal of the high voltage is grounded the MOD post carries the negative high voltage, thus a blocking capacitor will be required. This capacitor should be of sufficient size to pass the desired modulating frequency, and of sufficient voltage rating to withstand the negative high voltage. In selecting this capacitor, bear in mind that the input resistance is 200 ohms. Modulation may also be applied between the MOD post and the negative terminal of the high voltage; however, with positive grounding this will elevate the modulating source to negative high voltage.

2-12. USE AS A COMPARISON VOLTMETER. Because of its calibration, this power supply may be employed as a comparison voltmeter. To do this, set up the equipment as shown in figure 2-1 and proceed as follows:

a. With the external voltmeter set to the least sensitive range, adjust the HV CONTROL to reduce the meter indication.

b. Progressively increase the voltmeter sensitivity and reduce the meter indication as in step a, above.

c. When the meter indication has been reduced to zero, read the voltage from the calibrated HV CONTROL dial markings or numerical readout.

2-13. RESOLUTION. Because of the high resolution of the ten-turn potentiometer (HV CONTROL), the lower voltages normally employed in transistor work can easily be set. Where still higher resolution is

desired, the ten-turn control may be used for a course setting and the VERNIER CONTROL for fine setting. For voltages less than 3 volts, the VERNIER CONTROL alone may be used, with the HV CONTROL set at zero.

2-14. SMALL SIGNAL MEASUREMENTS. One method for the measurement of transistor parameters requires the superposition of a small ac signal on one of the dc potentials. Model 209B or 219B is particularly suitable for this since the dc voltage may be set independently, and modulation then introduced to provide the required small signal (subject to the instructions given in paragraph 2-11). In this connection it should be noted that more modulation is available as the load current is increased (due to the reduced time constant of the output system). Accordingly, where the available modulation is insufficient at loads less than maximum, some additional dc load may be added to permit greater modulation.

2-15. BRIDGE MEASUREMENTS. As described in paragraphs 2-13 and 2-14, model 209B or 219B may be used to provide separately adjustable ac and d excitation for bridges, strain gauges, etc.

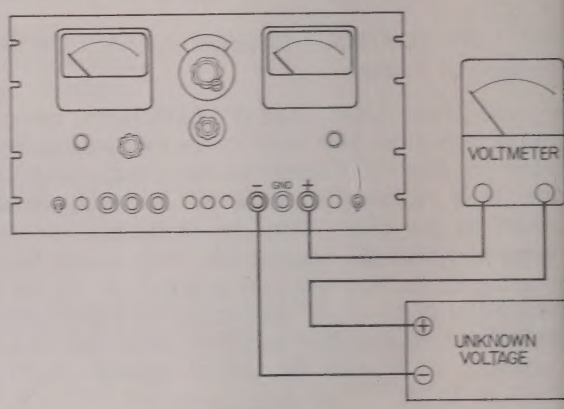


Figure 2-1. Comparison voltmeter setup.

SECTION III
MAINTENANCE

NOTE

Attention is called to the Warranty under which this equipment is sold, printed on the front inside cover of this instruction manual.

3-1. PARTS REPLACEMENT. An electrical parts list accompanies the schematic diagram in the rear of this instruction manual. In general, replacement parts are completely defined by the values and tolerances indicated on the parts list. The following components, however, require special attention:

a. Tubes V5 and V11. Replacement of either of these tubes will affect null balance, which should therefore be readjusted in accordance with paragraph 3-3.

b. Tube V10. Replacement of this tube will change the internal reference voltage somewhat, and will necessitate recalibration in accordance with paragraph 3-7. If the replacement tube does not yield approximately correct calibration, or proves unstable, a satisfactory tube will be furnished by the factory upon request.

c. HV and VERNIER CONTROLS. If either of these potentiometers is defective, it is advisable to obtain an exact replacement. If none is available locally, an order should be addressed to the factory.

3-2. SERIES TUBE FAULTS. In selecting replacement series tubes, or when a malfunction appears to result from a faulty series tube, the following procedure is recommended:

a. Remove all series tubes but one.

b. Turn on the power and apply 1/N of full load current at some low voltage, where N = total number of series tubes used in the power supply.

c. Check ripple and regulation.

d. Remove the remaining series tube, place another series tube in another socket, and repeat steps b and c, above. Repeat these steps for every other socket and tube, taking one at a time.

e. If one or more series circuits tests faulty, repeat the test in each case with a tube known to be satisfactory. If the repeated test proves favorable it may be assumed that the previous tube is defective. Otherwise the associated circuit should be checked for faults.

3-3. NULL ADJUSTMENT. The ZERO screwdriver adjust control permits adjustment of the balanced input detector to null or zero level. This adjustment, which holds over the entire operating range, is made as follows:

a. Set the HV and VERNIER CONTROLS at zero (fully counterclockwise).

b. Connect a voltmeter between the high voltage output binding posts. The voltmeter should be set for a full scale sensitivity of 3 volts dc or less.

c. Adjust the ZERO control to obtain a zero indication on the voltmeter. A very sensitive indication may be obtained by alternately connecting and disconnecting the voltmeter test leads.

3-4. CALIBRATION. The CAL screwdriver adjust control permits close agreement between control numerical readout or dial markings and output voltage. The calibration adjustment should not be performed unless a highly accurate voltmeter or source of voltage is available. The preferred calibrating voltage is 300 volts.

3-5. CALIBRATION WITH ACCURATE VOLTMETER. If an accurate voltmeter is employed, proceed as follows:

a. Connect the external voltmeter between the high voltage output binding posts.

b. Set the HV CONTROL at 300, and set the VERNIER CONTROL at zero.

c. Adjust the CAL control until the voltmeter indicates exactly 300 volts.

3-6. CALIBRATION WITH EXTERNAL PRECISE SOURCE OF VOLTAGE. If an external, precise source of voltage is employed, proceed as follows:

a. Set up the equipment as shown in figure 3-1.

b. Set the HV CONTROL to the exact calibrating voltage, and set the VERNIER CONTROL at zero.

c. Place the power supply in operation and adjust the CAL control for a zero indication on the external voltmeter. The voltmeter should be set to the lowest dc range available.

3-7. REFERENCE ADJUSTMENT. The reference voltage may be calibrated as described in paragraph 3-5 or 3-6 using the REF ADJ screwdriver adjust control. The HV and VERNIER CONTROLS do not require any adjustments for either method of calibration.

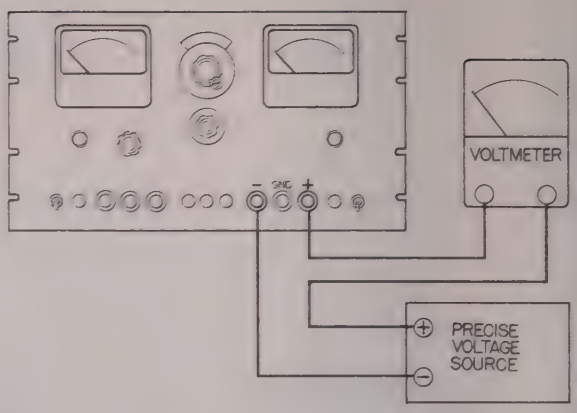


Figure 3-1. Calibration setup.

ELECTRONIC MEASUREMENTS CO.
EATONTOWN, NEW JERSEY

11/63
REF: 328-D-3E

ADDENDUM TO

PARTS LIST

MODEL 222A

Change TYPE OR PART NO. for Transformer T2 to: 5017

11/63

REF: 328-D-3E

ADDENDUM TO

PARTS LIST

MODEL 222A

for Transformer TZ to: 5017

PARTS LIST

MODEL 222A
115 Volts, 50-60 cps input

Revised 4-63

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
B1	Motor, shaded pole, 115V, 50-60 cps, 4 in. fan blade	DYAB-570-3	Barber-Coleman
*C1-C4	Capacitor, electrolytic, 120uf, 450 VDC, insul. sleeve	D32346	Sprague
*C5	Capacitor, electrolytic, 80uf, 300 VDC, insul. sleeve	D31964	Sprague
C6,8,10,20, 22	Capacitor, molded, paper, 0.05uf ±20%, 600 VDC	P161N157	Aerovox
C7	Capacitor, ceramic disc, 0.01uf, 1600 VDC	DD16-103	Centralab
C9	Capacitor, mica, 0.01uf ±5%, 500 VDC	MCM35E103J	Micamold
*C11	Capacitor, electrolytic, 20uf, 150 VDC, insul. sleeve	TD-20/150	Pyramid
C12	Capacitor, mica, 220uuf ±5%, 500 VDC	CM20B221J	Micamold
C13	Capacitor, mica, 15uuf ±5%, 500 VDC	CM20B150J	Micamold
*C14	Capacitor, electrolytic, 25uf, 25 VDC, insul. sleeve	Type 530	Neuberger
C15	Capacitor, mylar, 0.5uf ±20%, 1000 VDC	2111	Chicago Cond.
C16	Capacitor, paper, oil, 8uf, 1000 VDC	5225571 Pyranol	G.E.
*C17,18	Capacitor, electrolytic, 16uf, 600 VDC, insul. sleeve	MC-16/600	Pyramid
C19,21	Capacitor, mylar, 0.5uf +20% -10%, 400 VDC	2110BM	Chicago Cond.
*C23	Capacitor, electrolytic, 16uf, 450 VDC, insul. sleeve	TD-16/450	Pyramid
*CR1-CR4	Rectifier, silicon	CER71	Solitron
CORD	Line cord, 7' lg., #14 gauge, 3 cond., 3 prong plug	328-B-101	EMC
*DS1,2	Lamp, 6.3V, 0.25A.	44	G.E.
E1,2,3,8,9, 10	Post, binding, black	9738-19	Eby
E4	Link, shorting	328-D-20	EMC
E5,6,7	Post, binding, black	7699	Eby
*F1	Fuse, cartridge, 15A.	3AG15	Sightmaster
*F2	Fuse, cartridge, 10A.	3AG10	Sightmaster
K1-TDR	Time delay relay, DPST, 115V, 60 cps	328-D-80	EMC
M1	Milliammeter, 0-500 MADC ±2% full scale	Model 647/MA500	EMC
M2	Voltmeter, 0-1000 VDC ±2% full scale, external multiplier (R83)	Model 647/V1000	EMC
R1-R8	Resistor, fixed, comp., 82K ±10%, 2W	HB-8231	Allen-Bradley
R9	Resistor, fixed, comp., 1 megohm ±10%, ½W	EB-1051	Allen-Bradley
R10	Resistor, fixed, comp., 330 ±10%, 1W	GB-3311	Allen-Bradley
R11,19,41, 60,63,66, 69,72,75, 78,81	Resistor, fixed, comp., 470 ±10%, 1W	GB-4711	Allen-Bradley
R12	Resistor, fixed, comp., 3300 ±10%, 1W	GB-3321	Allen-Bradley
*R13	Resistor, fixed, deposited film, 1.5 megohms ±1%, 1W	Type NA25	Cont'l-Wirt
*R14	Resistor, fixed, deposited film, 1 megohm ±1%, 1W	Type NA25	Cont'l-Wirt
R15,18,57,58	Resistor, fixed, comp., 120K ±10%, 1W	GB-1241	Allen-Bradley
R16	Resistor, fixed, comp., 150K ±10%, 1W	GB-1541	Allen-Bradley
*R17	Resistor, fixed, deposited film, 220K ±1%, 1W	Type NA25	Cont'l-Wirt
R20,25,43	Resistor, fixed, comp., 220K ±10%, 1W	GB-2241	Allen-Bradley
R21,44	Resistor, fixed, comp., 2.2 megohms ±10%, 1W	GB-2251	Allen-Bradley
R22	Resistor, fixed, comp., 10K ±10%, 1W	GB-1031	Allen-Bradley
R26	Resistor, fixed, comp., 680K ±10%, ½W	EB-6841	Allen-Bradley
*R27,34	Resistor, variable, WW, 3000 ±5%, 2W, linear taper, 1/4 in. dia. by 1/8 in. lg. slotted shaft, Series 43	CM18923	Clarostat
*R28	Resistor, variable, WW, 1000 ±5%, 2W, linear taper, 1/4 in. dia. by 1/2 in. lg. shaft, Series 43	CM21188	Clarostat
R28A	Resistor, fixed, comp., 8200 ±10%, 1W	GB-8221	Allen-Bradley
*R29	Resistor, variable, WW, 10 turn, 300K ±3%, 8W, linear taper, 1/4 in. dia. by 1/2 in. lg. shaft at each end	Model 800 109	Spectrol

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
*R30	Resistor, fixed, WW, 80K ±1%, 3W	Type P3-W	Prec. Resistor
*R31,32,33	Resistor, fixed, WW, 3000 ±1%, ½W	Type TX-178	Prec. Resistor
R35	Resistor, fixed, comp., 270 ±10%, 2W	HB-2711	Allen-Bradley
R38	Resistor, fixed, WW, 1 ±5%, 1W	BW-1	Int'l Resistance
R39,59,62, 65,68,71,74, 77,80	Resistor, fixed, comp., 82 ±10%, 1W	GB-8201	Allen-Bradley
R40	Resistor, fixed, comp., 1.2 megohms ±5%, 1W	GB-1255	Allen-Bradley
R42	Resistor, fixed, comp., 1 megohm ±10%, 1W	GB-1051	Allen-Bradley
R45	Resistor, fixed, comp., 56K ±10%, 1W	GB-5631	Allen-Bradley
*R46	Resistor, fixed, deposited film, 120K ±1%, 1W	Type NA25	Cont'l-Wirt
*R47	Resistor, fixed, deposited film, 330K ±1%, 1W	Type NA25	Cont'l-Wirt
*R48	Resistor, fixed, deposited film, 390K ±1%, 1W	Type NA25	Cont'l-Wirt
*R49	Resistor, variable, WW, 10K ±5%, 2W, linear taper, 1/4 in. dia. by 1/8 in. lg. slotted shaft, Series 43	CM18924	Clarostat
*R50	Resistor, fixed, WW, 145K ±1%, 3W	Type P3-W	Prec. Resistor
*R51	Resistor, fixed, WW, 3000 ±1%, ½W	Type TX-178	Prec. Resistor
*R52	Resistor, fixed, WW, 60K ±1%, ½W	Type TX-176	Prec. Resistor
*R53	Resistor, fixed, deposited film, 80K ±1%, 1W	Type NA25	Cont'l-Wirt
R54	Resistor, fixed, WW, ceramic, 15K ±5%, 10W	10KT15K	Sprague
R61,64,67, 70,73,76, 79,82	Resistor, fixed, comp., 47 ±10%, 1W	GB-4701	Allen-Bradley
*R83	Resistor, fixed, WW, 1 megohm ±1%, 1W	Type WW5	Int'l Resistance
*RT1,2	Ballast tube	Amp 3-4	Amperite
*S1	Switch, toggle, SPST	160-73	Carling
*S2	Switch, toggle, TPDT	HL233-73	Carling
T1	Variable autotransformer	116U	Superior
T2	Transformer, filament	5014	EMC
T3	Transformer, power	5015	EMC
T4	Transformer, reference	5079	EMC
*V1,2	Electron tube	866A	RCA
*V3	Electron tube	6AC7	RCA
*V4	Electron tube	6U8	RCA
*V5,8,9	Electron tube	12AX7	RCA
*V6	Electron tube	5Y3	RCA
*V7	Electron tube	6L6GB	Sylvania
*V10	Electron tube	85A2/0G3	Amperex
*V11	Electron tube	0B2	RCA
*V12	Electron tube	0A2	RCA
*V14-21	Electron tube	6550 or KT88	Tung-Sol British Ind.
XDS1	Holder assembly, pilot lamp, green faceted lens	100	Drake
XDS2	Holder assembly, pilot lamp, red faceted lens	100	Drake
XF1,2	Extractor post, fuse, miniature	342003	Littelfuse

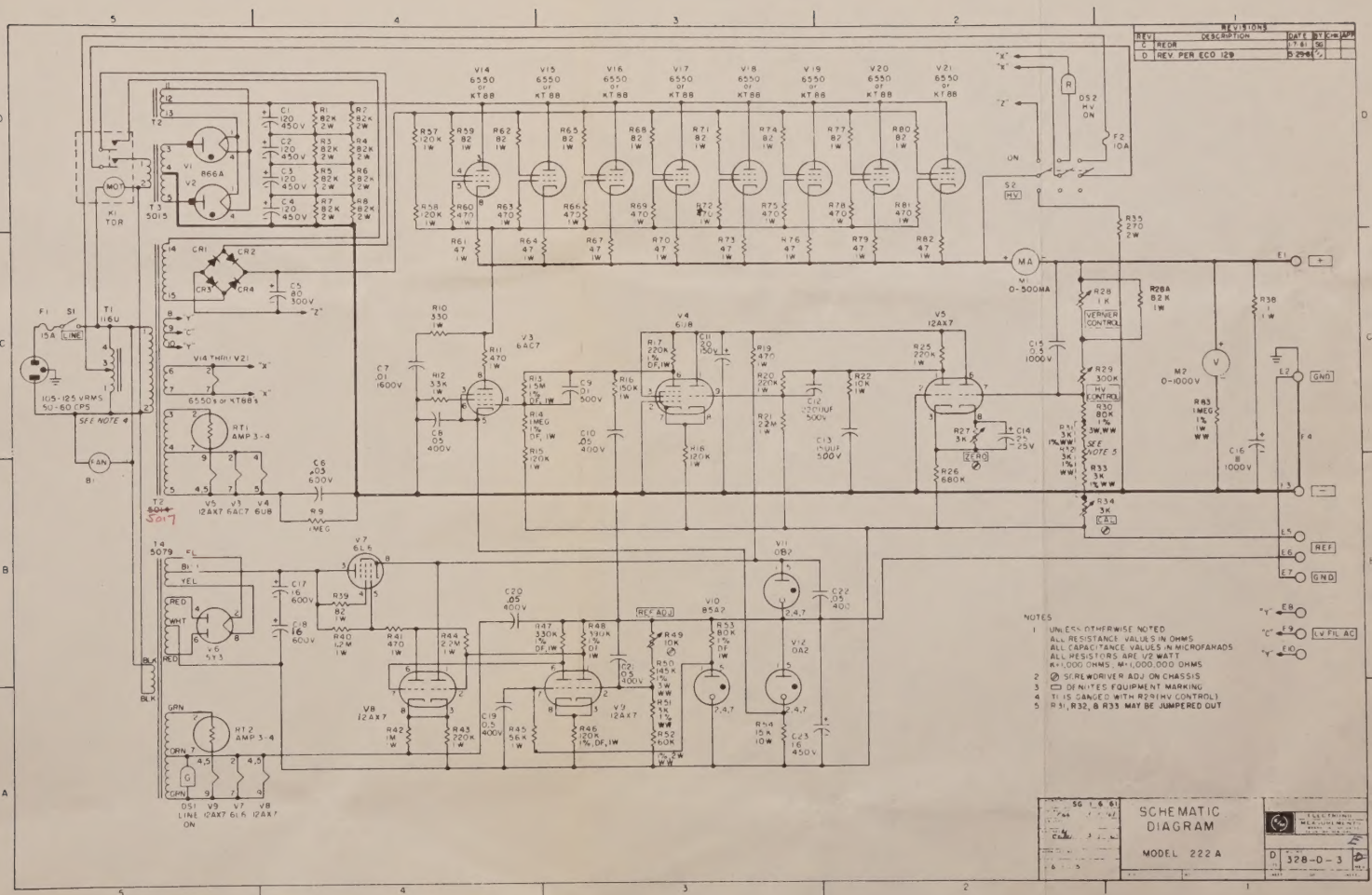
PARTS LIST ADDENDUM

220 volts, 50-60 cps input

B1	Motor, shaded pole, constant speed, 220v., 50-60 cps, 4 in. fan blade	1075-3174	Howard
*F1	Fuse, cartridge, 8A.	3AG8	Sightmaster
K1	Relay, 220v., 50-60 cps	328-D-80	EMC
*S1	Same as for 115 volt input		
T1	Variable autotransformer	216U	Superior
T2	Transformer, filament	5214	EMC
T3	Transformer, power		EMC
T4	Transformer, reference	5215	EMC

NOTES:

1. *ASTERISKED PARTS are recommended spares in quantity one per reference symbol, except fuses, which are three per reference symbol.
2. WHEN MAKING REPLACEMENTS: Part numbers are indicative of stock employed at the time of compilation of this list. Unless otherwise noted, and except for Electronic Measurements (E/M) numbers, "or equal" parts may be used for replacement. Electronic Measurements reserves the right to replace a part with an "or equal" part.
3. WHEN ORDERING PARTS FROM E/M: Include model and serial numbers of the instrument. Note carefully and include the letter suffix of any transformer number. In case of a discrepancy between a parts list number and the number actually printed on the part, employ the latter.
4. RECOMMENDED SPARES. When electrolytic capacitors are to be stored as spares for a year or more, request Technical Note 32.


REVISIONS
REV DESCRIPTION DATE BY CHK APP
C REDR 7-61 SG
D REV PER ECO 129 9-29-61
SCHEMATIC DIAGRAM
MODEL 222A
328-0-3
NOTES
1 UNLESS OTHERWISE NOTED
ALL RESISTANCE VALUES IN OHMS
ALL CAPACITANCE VALUES IN MICROFARADS
ALL RESISTORS ARE 1/2 WATT
K=1,000 OHMS; M=1,000,000 OHMS
2 SELECTED AT FACTORY
3 INDICATES EQUIPMENT MARKING
4 THIS GANGED WITH R29 (HV CONTROL)
5 R31, R32, & R33 MAY BE JUMPERED OUT
105-125 VRMS 50-60 CPS
SEE NOTE 4
6550's or KT88's
V14 THRU V21
0-500MA
0-1000V
VERNIER CONTROL
HV CONTROL
ZERO
CAL
LINE
ON
REF ADJ
LV FIL AC
REF
GND

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